THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual summer meeting of the Institution of Naval Architects was held last week, at Southampton, commencing on Tuesday, July 24, and concluding on the Friday following.

The President of the Institution, Lord Brassey, occupied the chair during the sittings, which were held in the theatre of the Hartley Institute. There were only seven papers set down for reading during the three sittings that were held for business purposes, the meeting being, perhaps, rather more of a social nature than usual. The following is a list of the papers:—

(1) "On the Harbour and Docks of Southampton," by John Dixon, Dock and Marine Superintendent of the London and South Western Railway Company.

(2) "On the Importance of Economy of Fuel in very Fast Vessels, and on the advantages to be derived from Heating the Feed-water," by J. A. Normand, of Havre.

(3) "On the Influence of Circulation on Evaporative Efficiency of Water Tube Boilers," by J. I. Thornycroft.

(4) "On the Design of Mail Steamers, with special reference to their use for War Purposes," by J. H. Biles.

(5) "On a Rapid Method of Calculating Wetted Surfaces," by Archibald Denny.

(6) "Recent Experience with Cylindrical Boilers and the Ellis and Eaves Suction Draught," by F. Gross.

(7) "The Ventilation of Steamships, with special reference to the Removal of Explosive and Foul Gases from Bulk Oil Steamers," by S. H. Terry and J. F. Flannery.

Mr. Dixon's paper does not call for extended reference at our hands; it was intended chiefly as a guide to members who were about to visit the Southampton Docks in the afternoon, and was excellently designed for this purpose. Perhaps the most generally interesting part of the paper was contained in the appendices, in which a brief history was given of the various steamship companies that used the docks at Southampton. In a note attached to the paper, some interesting historical details were given. Although Southampton is a very ancient town, its importance was not great in the early days of this century. In the year 1811, we learn that the chief trade was with Jersey, Guernsey, Alderney, and Sark. Several sloops were running between these islands and Southampton. There was also a carpet and a silk manufactory, as well as mills for manufacturing blocks and pumps for the Navy. The number of houses in the town then was 1582, and the population was under 8000. The ship-building industry, however, goes back to very early days, Mr. Dixon stating that in the reign of Henry V. the famous ships *Grace Dieu* and *Holy Ghost* were built at Southampton; this was about the year 1414. One of the vessels was built by Robert Berd, and the other by William Soper; and it is curious to notice that one of the well-known yacht-designers of the district is now a Mr. Soper. Each of the ships referred to cost about £500. During the last century, and in the early days of this century, a very large number of ships for the Royal Navy were built in this district. At a small place called Bucklers Hard, now seldom heard of, a number of famous ships were constructed. This is on the little river Exe, which flows through the New Forest and past Beaulieu Abbey to the Solent. Three ships of the British Fleet which were at Trafalgar, were built there, the most celebrated being Nelson's *Agamemnon* and the *Swiftsure*. Another interesting historical fact stated by Mr. Dixon, was that the timbers of the celebrated American frigate *Chesapeake* were used, when that vessel was broken up, in the construction of a mill at Wickham, near by. The building still exists, and is known as "Chesapeake Mill." The late Admiral of the Fleet, Sir Provo W. Parry Wallis, who died only a short time ago, in 1813 took the *Chesapeake* into Halifax, after her encounter with the *Shannon*.

M. Normand's paper was one of considerable value, and, though short, contained a good deal of useful information. The well-known scientific attainments of French naval architects are excellently represented in M. Normand's firm, and from the Havre yard have been turned out some of the torpedo boats which have been most worthy to be placed in competition with the productions of the Thames builders, Thornycroft and Yarrow. M. Normand is an original designer, his conclusions being based on scientific deduction. He is not content, as some other constructors of fast vessels are, to simply follow the lead of others, ignorantly copying whatever they may see to be successful. As is usually the case with scientific workers, M. Normand is generous in giving information to others, even to his competitors; although he would probably be the first to acknowledge his indebtedness in this respect to the two leading torpedo boat-builders of this country. Indeed, the interchange of information in this way across the channel has always been a pleasant feature in the rivalry of the builders of these beautiful little craft. Torpedo boats are not supposed to be economical vessels, and it has been said that "the mission of a torpedo boat is to run a trial trip." There certainly was a great deal of truth in this remark in the old days of premium for speed, when a boat might earn for her builders several thousand pounds over her contract price if she could scramble through her six runs on the mile without breaking down. In such a case, as there was no restriction in regard to coal burned, economy of fuel was little thought about, and indeed in the ultimate work for which torpedo boats are designed, should they ever be brought to the stern realities of war, it would be a small matter whether much or little coal were burned to attain the high speed. To get to the scene of operation, however, a torpedo boat might have to run a long distance, and in that case her radius of action in regard to coal stowage would be a serious consideration. Moreover, trial trips of torpedo boats now extend over a considerable length of time, and the amount of coal that has to be carried has become an important factor in regard to the total weight, which, of course, in turn governs the speed to a large extent. M. Normand has recognised these facts; he tells us that in his last torpedo boats he has found, by the official trials, that the coal burned per I.H.P. per hour ranged from 1·1 lb. up to 15 knots, and to somewhat less than 2 lb. at 25 knots. These figures seem very low, and the author is certainly within the mark in saying that the consumption is not more than two-thirds of that of a number of similar craft. Another interesting and valuable piece of information, given us by M. Normand, is that the total weight of engines and boilers of the boats above alluded to, is about 48 lb. per maximum I.H.P. and even this extremely light machinery is further reduced in weight, notably in the case of the *Forban*, now under construction at Havre; a vessel, it will be remembered, which is expected to reach a speed of 30 knots an hour, although we believe the contract speed is 29 knots. It may be mentioned here, that Mr. Yarrow has under construction, for the Russian Government, a vessel which is guaranteed to make 30 knots. M. Normand further tells us in his paper, that in high-speed vessels a reduction in the weight of any part of the ship allows the whole displacement to be reduced by about 4½ times the weight saved, if the speed, steaming distance, weight of armament, and general conditions remain unchanged. The author attributes the remarkable economy of his engines to several causes, but more particularly to the feed-heater that he uses. This, he informs us, gives an economy in fuel of at least 20 per cent. The figures seem somewhat startling, but they are vouched for by the author, and have been obtained on official trials. The principle of this feed-heater was enunciated for the first time in 1886 by the author's brother, M. Benjamin Normand. It is a direct application of the first law of thermodynamics. The heating steam is taken, in the ordinary compound engine, at mid-stroke from the low-pressure cylinder by a special valve. In three or four stage expansion engines it is taken direct from the low-pressure casing, all the work previously given in the engine by the heating steam being a direct gain. The author ascribes the economy of 20 per cent., before mentioned, to two causes, viz.: (1) That which results from the number of thermal units saved by using, for heating the feed, steam which has already done work. This may amount to from 10 per cent. to 14 per cent., according to the pressure. (2) That which results from the better circulation of the water in the boiler, a greater proportion of that water being at a boiling temperature. As a practical example of the advantages of this heater, it may be stated that simply by putting it into use, the revolutions of the engine in one vessel were increased from 305 to 335 per minute.

A short discussion followed the reading of this paper, in which both Mr. Thornycroft and Sir Nathaniel Barnaby took part. The chief point of interest was the statement by Mr. Thornycroft, that in the case of the *Daring*, a torpedo boat destroyer recently built by his firm, he believed the weight of machinery per I.H.P. was even less than that stated by M. Normand.

Mr. Thornycroft's paper, like that which preceded it, contained a good deal of valuable information in a small compass.

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It dealt especially with one feature in the boiler which has been invented by the author. This steam generator, it will be remembered, consists chiefly of three horizontal cylinders arranged, in cross section, in the form of a triangle. Two of the cylinders are placed in the wings of the furnace, whilst the third, which is above, at the apex of the triangle, the fire-grate forming the base. The top cylinder is connected to the two wing cylinders by two series of curved pipes, which are so arranged as to deliver into the top cylinder at its upper part; they thus deliver above the water-level of the boiler, which is about half-way up the top cylinder. Connecting the top cylinder with the two wing cylinders, respectively, are two external pipes; the whole, of course, is enclosed by a smoke-jacket, and the steam generation occurs in the connecting pipes. The method of working of the Thornycroft boiler is as follows:—The heat from the furnace playing on the pipes or tubes, which connect the top cylinder to the two wing cylinders, causes generation of steam, the flow of which is upwards. As is nearly always the case when steam is generated in small pipes, a great deal of water is also carried upwards with the steam. This water is delivered into the top cylinder, and from thence is free to flow downwards to the two wing cylinders, from whence it can rise again through the generating tubes, and so on in continuous cycle so long as there is water to be evaporated. The success of a water-tube boiler in practical working may be said to be dependent on its circulation, so that when rapid evaporation takes place, and water is quickly driven away from the heating surface, other water should be there to flow in to take its place. Mr. Thornycroft has always claimed that this circulation is most effectually attained by having the steam-generating tubes deliver in the upper part of the top cylinder. The principle has been questioned, and in order to set the matter at rest experimentally, the author had made a boiler purely on his system, and also one in which the design was so modified as to bring the generating tubes into the top cylinder below the water surface. If we have made our explanation clear, it will be seen, as stated by the author, that in either boiler, pressure in the lower vessel is that due to the full depth of water in the boiler, in addition to the steam pressure, and reduction of density in the generating tubes will be available for causing circulation; whilst reduction in pressure in the wing cylinder below that due to the head of water in the boiler, will reduce the circulation. In fact, the circulation of water in the boiler is governed by variations of pressure. In order, therefore, to measure these variations, Mr. Thornycroft had recourse to a water gauge connecting the top and bottom cylinders, the height of the column of water showing the greater or lesser pressure in the wing cylinder. The results of the trials were shown by a diagram in which curves were assigned to each series of experiments. When the steam-generating tubes were arranged as in the normal Thornycroft boiler, as the rate of evaporation increased, the height of the water in the gauge-glass showed a steady and comparatively small pressure in the wing cylinder. Thus, when the evaporation was increased from 3 lb. to 20 lb. per square foot of heating surface per hour, from and at 212° Fahr., the fall was about 2 inches of water. With the boiler having tubes delivering below the water-level when the evaporation was raised from 3 lb. per hour per square foot of heating surface to about 15 lb., the fall in pressure in the wing cylinder was from 3 inches to 7 inches, roughly. Thus it will be seen that the circulation of water in a boiler of this class, where the tubes deliver above water-level, must be more energetic than when the tubes deliver below water-level. In both of these experiments, what are called the down-comer tubes, that is to say, the two tubes at the ends of the cylinders provided for completing the circuit of circulation, were in use. The utility of these tubes has, however, been questioned, and in order to throw light on this point, Mr. Thornycroft next made a series of experiments with a boiler in which the tubes delivered below the water-level, and the down-comer tubes were out of use. The results were interesting and instructive. The reduction in pressure in the wing cylinder was extremely rapid as the evaporation increased; after a time, however, the curve reached its lowest point, and then suddenly bent upwards, showing an increase in the pressure. This last phenomenon Mr. Thornycroft attributed to the fact that the steam, instead of rising uniformly in the tube, as it would when the evaporation was moderate, was driven out at the lower end; and this, of course, would tend still more to check the circulation. The diagram is well worthy of study on the part of those interested in any class of boiler design, and it may be found in the *Transactions* of the Institution.

In the discussion which followed the reading of this paper, the most interesting feature was a description, by Mr. Pilcher, of the device used by Mr. Maxim in making the boiler of his flying machine. This boiler, it may be stated, is a marvel of lightness. It is a Thornycroft boiler with very small generating tubes about ¾ inch in diameter; it is said to have given off steam equivalent to 300 I.H.P. at a pressure of 300 lb. to the square inch; the weight of the boiler itself being but 3 lb. per I.H.P. With the small diameter tubes it was found impossible to keep up circulation sufficient to prevent the destruction of the boiler, and, in order to aid the natural circulation, Mr. Maxim introduced what may be described as injector circulation. He carried the feed-pipe of the boiler into the down-comer tube, covering the orifice of his feed-pipe by a conical valve, which was attached to a long spindle, and, working through a stuffing-box, was carried outside the pipe. The valve was kept closed by means of an external spiral spring, so adjusted as to give a pressure of 50 lb. to the square inch on the valve. The feed-pump naturally would overcome this additional pressure, so that the pressure in the feed-water on the boiler side of the pump would be 50 lb. above the boiler pressure, and thus 350 lb., the boiler pressure being 300 lb. It will be seen, therefore, that, on the hydraulic pressure opening the valve, the feed-water would be injected with some velocity into the boiler, and thus would set up a circulating current. In this way it was found that the boiler in the flying machine could be made to work very perfectly.

Prof. Biles, in his paper, described a method by which he proposed to transform mail steamers into war vessels in the event of hostilities. Details were worked out by the author, and given in the paper; but into these we need not enter. The most noticeable feature was a long recess in the side of the ship, into which the author proposed to pack an armoured belt when the vessel was required to take up its warlike *rôle*.

The scope of Mr. Denny's paper is described by its title. Mr. Morrish, of the Admiralty, in the discussion which followed, gave a formula used by Mr. Froude at Haslar, which appeared to us even more simple than the method described by Mr. Denny. We must refer our readers to the *Transactions* for these formulæ.

Mr. Gross gave details of certain trials made with the system of burning fuel in steam boilers, referred to in the title of his paper. A very good result in regard to economy of fuel was obtained with one vessel referred to; the consumption being 1·3 lb. per I.H.P. per hour of South Wales coal for the main engines. We fail to see, however, in what respect "suction" draught differs from "forced" draught in regard to economy. As Sir Edward Harland humorously stated in the discussion: "If one wishes to remove a person from a certain position, it does not much matter whether one gives him a pull by the nose, or applies pressure from behind." There may, of course, be some occult virtue in "suction" as compared to pressure, but we certainly have never heard it satisfactorily accounted for.

The last paper was read by Mr. Terry. It is remarkable how those tank steamers which carry oil in bulk may be freed from the insidious vapours which always arise whenever a little of these hydrocarbon oils are present. Mr. Terry tells us—and he is confirmed in this by Mr. Martell, Lloyd's chief surveyor, who has naturally had thorough opportunities of seeing these matters in practical work—that, in the same spaces that have been occupied by petroleum, rice, and other perishable food, cargoes have been carried without detriment. So successful have the results been, that it is now proposed to carry even tea in these tank steamers.

We cannot deal with the many pleasant excursions that were really the leading feature of the meeting. The proprietors of the various mail steamers, the London and South-Western Railway Company, and those gentlemen who had estates in the neighbourhood, seemed to vie with each other in entertaining the members of the Institution. On Friday morning a visit was paid to Portsmouth Dockyard, where many interesting features were shown by Admiral Fane, the superintendent, and the officers of the permanent staff. In the afternoon an excursion was made round the Isle of Wight, on board the *Frederica*, a vessel of 1509 tons, and about 6000-h.p., which had been lent by the London and South-Western Railway Company for the purpose.

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